REMARKS

Claims 2-4, 10-15, 20, 23-26 and 29 are canceled, and new claims 30-33 are added. No new matter was added. Thus, claims 1, 27, 28 and 30-33 are pending. Independent claim 1 has been amended to distinguish over the prior art of record. Accordingly, Applicant respectfully submits that the present application is in condition for allowance.

**I. Claim Rejections - 35 USC §103(a)**

*In the FINAL Office Action dated August 28, 2008, claims 1, 2 and 26-29 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo.*

Independent claim 1 of the present application has been amended to include the limitations of former dependent claims 2 and 29. No new matter was added. Accordingly, claim 1 requires a hafnium sputtering target or thin film that has a purity of 4N5 to 6N and a zirconium content of 1 to 1000wtppm.

In the FINAL Office Action, the Shindo prior art is relied upon as teaching a high-purity hafnium of 4N (99.99wt%) and having a zirconium content of 0.5wt% (5000ppm) or less. More specifically, it is stated that:

> "Thus it would have been obvious to one of ordinary skill in the metallurgical arts at the time the invention was made, taking the disclosure of Shindo as a whole, to produce the hafnium target of claims 27-29 as one could optimize the prior art ranges taught by Shindo to form a high purity hafnium material."

Applicant respectfully disagrees that claim 1, as amended, is obviated by the Shindo prior art or that one of ordinary skill in the art could simply optimize the prior art ranges taught by Shindo. Accordingly, Applicant respectfully requests reconsideration for reasons stated in greater detail below.

A. Background Information

The cited prior art reference, U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo, corresponds to U.S. Patent No. 6,861,030 B2 issued to Shindo. Yuichiro Shindo, the inventor of the present application, is the inventor of the invention disclosed in the cited application publication and above referenced issued patent. Nippon Mining and Manufacturing Co., Ltd. is the assignee of the present application and the cited reference. Accordingly, Applicant is well aware of the cited reference and its disclosure.

The present application **discloses an advancement** of the art over that disclosed in Applicant's earlier filing. Applicant respectfully submits that the '261 Shindo application publication (or the '030 Shindo patent) fails to disclose the present invention and fails to render the present invention obvious. The refining of high purity hafnium in the cited reference is different than that of the present invention, and most importantly, the awareness of the importance of the presence of zirconium in the high purity hafnium is distinctly different. It should be understood that high purification of hafnium with respect to zirconium is complicated and extremely difficult to achieve and should not be considered trivial or obvious. In addition, Applicant respectfully submits that the significance of the advancement provided by the present application should not be overlooked.

B. The '261 Application Publication/'030 Patent of Shindo

The cited reference discloses hafnium of a 4N (99.99%) purity. This purity specifically excludes zirconium and gas components (such as oxygen, carbon and nitrogen) as impurities in determination of the stated purity level. For example, see column 9, lines 2-4, of the '030

Shindo patent and corresponding Paragraph No. 0090 of the '261 Shindo published application. This is conventional practice with respect to the purity of hafnium.

It should also be noted that the cited reference fails to disclose a refining step of separating zirconium via solvent extraction. This step makes it possible to obtain hafnium of 4N5 to 6N purity and makes it possible to reduce zirconium content to extremely low levels, such as 1 to 1000wtppm. (By way of example, see the present application, as filed, on: page 2, line 33, to page 3, line 15; page 4, lines 8-12 and 20-31; page 5, lines 26-28; page 6, lines 19-21; and page 8, lines 1-3 and 11-12.)

With respect to zirconium content, the cited reference discloses the following:

> " ... a large quantity of zirconium is contained in hafnium, and notwithstanding the fact that the separation and refinement between the two is difficult, this may be ***disregarded*** since the purpose of use of the respective materials ***will not hinder*** overall purpose hereof" (see column 6, lines 12-16, of the '030 Shindo patent and Paragraph No. 0061 of the '261 Shindo published application); and

> "It is ***extremely difficult to reduce Zr*** in high purity hafnium ... the fact that Zr is mixed in high-purity hafnium ***will not aggravate*** the properties of semiconductors, and ***will not be a problem.*** " (See column 6, lines 44-48, of the '030 Shindo patent and Paragraph No. 0065 of the '261 Shindo published application)"

The cited reference teaches that raw material hafnium will have about 25000wtppm of zirconium. See column 8, Table 3, and column 12, Table 3 of the '030 Shindo patent, and see Paragraph Nos. 0088 and 0126 of the '261 Shindo published application.

The cited reference teaches that the hafnium can be refined such that zirconium content is reduced to 3500wtppm or 2400wtppm (0.24wt%). See column 8, Table 4; column 9, lines 35-38; and column 13, Table 4 of the '030 Shindo patent, and see Paragraph Nos. 0089, 0095 and 0131 of the '261 Shindo published application.

Further, the cited reference states that "the content of Zr is 0.5wt% or less". See column 3, line 49; column 4, lines 31-32; column 6, lines 44-48; and claims 15-20 of the '030 Shindo patent, and see Paragraph Nos. 0031, 0040 and 0065 and claims 7, 15 and 26 of the '261 Shindo published application.

C. Reasons for Patentability of the Present Invention

Applicant respectfully submits the following reasons for the patentability of claim 1, as amended, of the present application over the '030 Shindo patent/'261 Shindo published application:

(i) it would not have been obvious to one of ordinary skill in the metallurgical arts at the time the invention was made, taking the disclosure of Shindo as a whole, to produce a hafnium sputtering target or thin film having a purity of 4N5 to 6N (which requires a multistage solvent extraction step);

(ii) it would not have been obvious to one of ordinary skill in the metallurgical arts at the time the invention was made, taking the disclosure of Shindo as a whole, to produce a hafnium sputtering target or thin film having the zirconium content required by claim 1, as amended, of the present application or the common sense need or motivation for such extreme reduction.

(i) Purity Level

On column 8, line 64, to column 9, line 4, of the '030 Shindo patent (or on Paragraph No. 0090 of the '261 Shindo application publication), the following purity is disclosed:

"As shown in Table 4, as a result of the hafnium sponge having the purity level of (2N level) shown in Table 3 being cleansed with fluoride nitrate and subjected to electron beam melting, the content of zirconium and impurities excluding gas components such as oxygen and carbon become less than 100ppm, and **high-purity hafnium having a purity of 4N (99.99%) level** excluding zirconium and gas components such as oxygen and carbon was obtained thereby."

Also see column 13, lines 33-40, of the '030 Shindo patent (or Paragraph No. 0133 of the '261 Shindo application publication), which states:

"As shown in Table 4, as a result of the hafnium sponge having the purity level of (2N level) shown in Table 3 being cleansed with fluoride nitrate and subjected to electron beam melting, the content of zirconium and impurities excluding gas components such as oxygen and carbon become less than 100ppm, and **high-purity hafnium having a 4N (99.99%) level** excluding zirconium and gas components such as oxygen and carbon was obtained thereby."

Accordingly, one of ordinary skill in the art is taught how to produce hafnium having a 4N level of purity. There is no mention or suggestion with respect to obtaining 4N5 level purity or 6N level purity.

In contrast, the present application starts with a raw material of zirconium tetrachloride ($HfCl_4$). See page 4, lines 20-21, of the present application, as filed. This is dissolved in purified water and subjected to multistage organic solvent extraction, such as solvent extraction performed in 1 to 10 stages. See page 4, lines 27-29, of the present application, as filed. Such raw material or solvent extraction step is not disclosed in the '030 Shindo patent or the '261 Shindo application publication. Further, the present application expressly states on page 5, lines 26-28, that:

"According to the present manufacturing method, as described above, the zirconium content in the hafnium can be reduced down to 1wtppm, and a total purity of 6N can be achieved."

There is no such disclosure in the cited reference.

Also, see the 4-stage organic solvent extraction step in Example 1, page 6, lines 7-8, and the 20-stage organic solvent extraction step in Example 3, page 7, lines 24-25, of the present application, as filed. A "purity level of 4N5 (99.995wt%)" is obtained in Example 1 and a "purity level of 6N (99.9999wt%)" is obtained in Example 3 of the present application. See page 6, lines 19-21, and page 8, lines 1-3, of the present application, as filed.

Applicants respectfully submit that the obtained purity level is an unobvious and patentable difference between the disclosure provided by the cited prior art reference and claim 1, as amended, of the present application. For at least this reason, Applicant respectfully requests reconsideration and removal of the above referenced rejection of claims 1, 27 and 28 of the present application.

(ii) Zirconium Content

In the FINAL Office Action, it is stated that the '261 Shindo published application discloses zirconium content of 0.5wt% (5000wtppm) or less.

Applicant readily admits that his earlier application publication and patent enable a zirconium content of 5000wtppm or less; for example, see the examples of 3500wtppm and 2400wtppm provided in the Examples of the cited reference.

However, the teaching provided to one of ordinary skill in the art by the cited reference, when taken as a whole, is completely different to that provided by the present application. As best stated on page 2, lines 11-13, of the present application, as filed, "the inclusion of zirconium or the inclusion of zirconium in hafnium was never really acknowledged as a problem."

Such a teaching is clearly provided by the cited prior art reference, which states that:

> " ... a large quantity of zirconium is contained in hafnium, and notwithstanding the fact that the separation and refinement between the two is difficult, this may be ***disregarded*** since the purpose of use of the respective materials ***will not hinder*** overall purpose hereof" (see column 6, lines 12-16, of the '030 Shindo patent and Paragraph No. 0061 of the '261 Shindo published application); and
>
> "It is ***extremely difficult to reduce Zr*** in high purity hafnium ... the fact that Zr is mixed in high-purity hafnium ***will not aggravate*** the properties of semiconductors, and ***will not be a problem.*** " (See column 6, lines 44-48, of the '030 Shindo patent and Paragraph No. 0065 of the '261 Shindo published application)"

Accordingly, the cited reference provides one of ordinary skill in the art with no common sense reason or motivation for reducing zirconium content below 0.5wt% (5000wtppm), 3500wtppm (0.35wt%) or 2400wtppm (0.24wt%). This is because one of ordinary skill in the art is taught by the cited reference that a large quantity of zirconium is contained in hafnium, that the separation and refinement between the two is difficult, and that the presence of zirconium "may be ***disregarded*** since the purpose of use of the respective materials ***will not hinder*** overall purpose hereof." Also, the cited reference teaches to one of ordinary skill in the art that it is "***extremely difficult to reduce Zr*** in high purity hafnium" and "the fact that Zr is mixed in high-purity hafnium ***will not aggravate*** the properties of semiconductors, and ***will not be a problem***."

Thus, one of ordinary skill in the art is provided with no common sense reasoning for reducing zirconium content below 0.5wt% (5000wtppm), 3500wtppm (0.35wt%) or 2400wtppm (0.24wt%).

In the cited reference, the starting raw material has 25,000wtppm of zirconium and this is reduced to 5,000wtppm (for instance, to 3500wtppm or 2400wtppm). Since this amount of zirconium ***will not aggravate*** the properties of semiconductors, and ***will not be a problem***, there is no common sense reason for further reduction by one of ordinary skill in the art following the teachings of the prior art reference, taken as a whole.

In contrast, the present application begins with a zirconium tetrachloride raw material that has a zirconium content that is already within the limits required by the cited prior art reference. For example, page 4, lines 22-23, of the present application, as filed, states that commercially available zirconium tetrachloride contains roughly 5wt% (5000wtppm) of zirconium. Accordingly, since this is within the required limits of the cited prior art reference, no further reduction of zirconium content would be thought to be required by one of ordinary skill in the art following the teachings of the cited reference.

As discussed above, the present invention requires multistage organic solvent extraction to reduce zirconium content to 1000wtppm or less, normally 1 to 200wtppm. See page 4, lines 30-31, of the present application, as filed.

Applicant respectfully submits that this is an unobvious and patentable difference between the disclosure provided by the cited prior art reference and the subject matter required by claim 1, as amended, of the present application. For at least this reason, Applicant respectfully requests reconsideration and removal of the above referenced rejection of claims 1, 27 and 28 of the present application.

**II. Conclusion**

In view of the above amendments and remarks, Applicant respectfully submits that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

Respectfully submitted,
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